DEPARTMENT OF ELECTRICAL ENGINEERING AND COMPUTER SCIENCE

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

CAMBRIDGE, MASSACHUSETTS 02139

February 7, 1992

Secretary, Federal Communications Commission
1919 M Street
Washington, DC 20554

Dear Sir,

Enclosed please find five copies of "Additional Reply Comments" of Professor William F. Schreiber. Please enter these "comments" into MM Docket #87-268 in the Matter of Advanced Television Systems and Their Impact upon the Existing Television Broadcast Service.

Thank you.

Sincerely,

William F. Schreiber

William F. Schreiber
Professor of Electrical
Engineering, Emeritus

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Before the Federal Communications Commission
Washington DC 20554

In the Matter of
Advanced Television Systems
and Their Impact upon the
Existing Television Broadcast Service

MM Docket No. 87-268
Notice of Proposed Rule Making
November 8, 1991

Additional Reply Comments of

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The opinions expressed herein are those of the author only.

6 February, 1992

Executive Summary

These remarks are addressed to the Reply Comments of AT&T. Since the date for Reply Comments is passed, this document is being mailed to the Commissioners directly as well as to others.

It is simply not true that digital transmission, by itself, enhances interoperability. A perfect example is given by the four current all-digital proposals, in which the coded signal must be completely decoded to baseband in order to transcode to any other format. (See footnote on page 4 of my Reply Comments.) This mistaken idea stands in the way of devising a workable terrestrial transmission format for the US.

Introduction

These additional reply comments are directed at the reply comments of AT&T. Nowhere in my comments or in the appendix or in any other paper that I have written did I say "...an all-digital ATV system with square pixels and non-interlaced scanning would facilitate development of ..." (AT&T Reply Comments, footnote on page 4). In fact, I do not believe that all-digital *transmission* facilitates any of the objectives of any new imaging system. What I did say (with respect to all-digital formats) is "This is not the case." (Appendix, page 8)

I do not currently advocate 3-d subband coding. With the improved channel utilization made possible by hybrid transmission, I believe that we can get very good pictures in 6 MHz over most of the viewing area without any temporal processing at all. Since this makes for a substantially simpler receiver, I believe this possibility is well worth investigating.

It *is* true that 3-d subband coding greatly simplifies interoperability. (See "Scalable Open-Architecture Television," V.M.Bove and A.B.Lippman, SMPTE Journal, Jan. 1992, pp 2-5). Even if 3-d subband coding produced images slightly inferior to those obtained with MPEG-type systems, it might well be preferable on account of its superior interoperability. Since it now seems that adequate performance as well as good interoperability can be achieved with 2-d subband coding and hybrid transmission, this tradeoff may not be necessary.[1]

The All-Digital Format

Proponents are flogging a dead horse when they advocate digital TV because of its flexibility and superior compression capability. These properties are those of the source coder, not the channel coder. All system proponents, including Sarnoff (ACTV) and NHK (Narrow MUSE) have *always*

[1]Note that the DCT (as well as the wavelet transform) is a special case of subband coding. Thus, the contention is not between subband coding and the DCT; the contenders are 3-d transforms vs. motion compensation and 2-d transforms.

used digital source coding. With today's technology, no competent system designer would advocate anything but digital processing in the encoder and decoder.

What is truly revolutionary about the four all-digital proposals is the use of terrestrial digital *broadcasting*, not digital source coding. Actually, all four use some version of MPEG source coding. There are likely to be differences among the systems, as the quality is bound to be scene-dependent, and it is necessary to handle critical scenes (lots of detail and lots of motion) in a graceful manner.

The question of digital *transmission* raises a host of additional problems that were not on the table at the time that the testing program was defined. As the calculations of service area (apparently not made at the time the systems were proposed, since they were published only recently) have shown, error-free operation at about 12 dB D/U ratio is required. This raises both quality and reliability issues. Assuming a white Gaussian noise channel, this leaves only 12.6 Mb/s (GI calculation) for video data, which is very small. Even this performance is not possible unless all other analog channel impairments are removed. All proponents are relying on adaptive channel equalizers for this purpose, and are making no allowance at all for less-than-perfect performance of the equalizers, even under the worst conditions of moving multipath.

In the experiment under way at the National Transcommunication Laboratories in Winchester, UK, a much more sophisticated system, OFDM, will be used in the field tests to be started this spring. They expect a transmission rate of 12 Mb/s in an 8-MHz channel and hope to get, not HDTV, but CCIR 601 quality.

Interoperability, Once Again

AT&T is quite right in saying that interoperability, while desirable, is not the main goal of the current proceding. An interoperability scheme that unduly increased the cost of normal use of the system for entertainment TV would not be viable. However, it is not proven that interoperabilty must be very expensive. Simple system decisions such as square pixels and progressive scanning are essentially cost free, and are helpful. However, they are far from giving a complete solution.

Much more thought is needed to deal with interoperability among systems of different spatial resolution. As I pointed out in my earlier comments, one way to do this, as demonstrated at Columbia, is to combine multiresolution source coding with a channel coder that has multiple thresholds. There may be other ways to do this, but no methods at all of achieving such a degree of interoperability will be tested in the current series.

Another important aspect of interoperability is that it is closely related to the possibility of nondisruptive improvement over time, which *is* a desired objective of the FCC in the current proceeding. As we learn how to make better encoders capable of producing better received pictures, we do not want to put older equipment out of business. This cannot be done by these MPEG systems, but might be done, as I have previously stated, by operating in the frequency domain and giving the receivers the capability of ignoring coefficients that they were not designed to use. In other words, a high degree of interoperability also permits nondisruptive improvement over time.